

Vehicle Dynamics

CME 3091 (1.6 CEUs)

This seminar is a collaborative course delivered with *Kettering University* and can be delivered in a combination, distance learning and/or live lecture format. It is a two-day, fundamental seminar which covers the following topics: Road Loads, Tire Mechanics, Acceleration Performance, Braking Performance, Ride Dynamics, Steady-State Cornering for single and multi-articulated situations (car vs. commercial vehicles), Trailer stability, Rollover. This course has been uniquely designed for persons seeking a fundamental understanding of the subject, math & simulation tools.

I. General Vehicle Dynamics

- a. Road Loads
 - i. Aerodynamic lift and drag, afterbody drag, forebody effects, underbody drag
 - ii. Internal friction, Rolling resistance
- b. Performance
 - i. Acceleration performance
 - 1. Tractive effort
 - 2. Effective inertia, effect of gear ratio
 - ii. Gradeability performance
 - 1. Power-limited gradeability
 - 2. Traction-limited gradeability
- c. Braking
 - i. Braking torque, effective inertia
 - ii. Traction limits, road adhesion
 - iii. Fore-aft load transfer (rear to front)
 - iv. Braking efficiency, stopping distance, optimal braking
 - v. Effects of tire lockup
- d. Ride Dynamics
 - i. Bounce & Pitch
 - ii. Road excitation
 - iii. Suspension, sprung & unsprung mass
 - iv. Body-suspension bounce and pitch natural frequencies; flexible body frequencies
- e. Cornering
 - i. Roll & Yaw
 - ii. Cornering force, tire properties
 - iii. Rollover moment
 - iv. Lateral load transfer
 - v. Suspension effects
 - vi. Flexible body effects
 - vii. Rollover threshold and tire lift-off

II. Heavy-Duty Articulated Vehicles

- a. Types of articulated vehicles
 - i. Tractor-Semitrailer

- ii. B-double (Tractor, two semitrailers, 5th wheel kingpin connections)
 - iii. Truck (3-axle) full-trailer (pintle hitch connection)
 - iv. A-double (Tractor-5th wheel-semitrailer-pintle hitch-full trailer)
- b. Braking of a Tractor-Semitrailer
 - i. Effects of tire lockup (tractor front tires, tractor rear tires, semitrailer tires)
 - ii. Load transfer mechanics and optimal braking
 - iii. Tractor-Semitrailer ABS systems
 - iv. Traction control Systems
- c. Cornering & Roll Dynamics
 - i. Lateral tire forces
 - ii. Overturning moment (lateral acceleration kinetics)
 - iii. Lateral load transfer
 - 1. Fixed payload
 - 2. Fluid payload
 - iv. Body roll angle, suspension roll stiffnesses, suspension moments
 - v. Couplings: lateral forces, roll and yaw moments
 - vi. Axle stiffness-to-load ratio, distribution of roll stiffness among suspensions
 - vii. Roll-over threshold and tire lift-off
 - viii. Active roll control – published simulations of steady cornering, step steering change, double lane change.
- d. Tools for analyzing dynamics of articulated vehicles
 - i. ArcSim Vehicle Dynamics Simulator (U.S. Army TARDEC; UMich ARC)
 - ii. Static Roll Threshold Calculator (New Zealand Land Transport Safety Authority)

Course Material

Provided by instructors

Instructors

T. Shim, Assistant Professor, Mechanical Engineering, College of Engineering & Computer Science, UM-Dearborn

T. Cameron, Professor, Mechanical Engineering, Kettering University, Flint, Michigan

Target Audience

This course is intended for engineers of all disciplines, scientists, and other technical personnel who are involved in data manipulations, signals and systems, control theory, and modeling techniques.

Continuing Education Units (CEUs)

A total of 1.6 CEUs will be awarded to each participant who completes the program. The CEU is a nationally recognized means of tracking non-credit continuing education development. It confirms participation in a structured professional development activity or course work. One CEU is awarded for 10 hours of completed activity or course work. A permanent record of each attendee's participation is maintained in the Office of the Registrar at the University of Michigan-Dearborn.

Register

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